EFFECT OF PRE-TREATMENT SOLUTIONS OF DRIED APPLE SLICES FROM SEVERAL CULTIVARS

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ABSTRACT

Apple is the most popular fruit in Hungary. After grape it is grown in the largest quantity. It has high health benefits, because apples contain many types of phenolic acid derivatives, flavonoids, and dietary fibres. Apples have important role of the fruit consumption in Hungary by fresh fruit and processed apple products.

Next to the fresh fruit consumption processing of apple is very important. It can be processed for pulp, dried slices (chips), juice, and concentrate. Nowadays dried slices (apple chips) have increasing tendency because consumers turn to the healthier crunches without chocolate, sugar, colorants, and preservatives. Dried apple slices match to these requirements.

The processing technologies have large and fast advance, food industry has focused on the development of new processing technologies for minimally processed fruit and vegetable. Food industry requires new apple candidates for processing technologies, as the well-known traditional varieties became old as indicated by its poor quality. In Europe a lot of country deals with selective breeding of apples. In Hungary an apple breeding program was started in the beginning of the '90s in order to widen the selection of Hungarian apple cultivars. Recently several Hungarian multi-resistant apple candidates are available for processing technologies. They are promising because of the smaller scale use of pesticides (environmental friend technology), and they have similar fruit quality to the commonly grown susceptible

In this study several types of apples (multi-resistant and common apple cultivars) were used for drying. To inhibit of the enzymatic browning ascorbic and citric acid were applied. It was investigated that it can be produce apple chips from these apple candidates without using sulphur. The main purpose of this study was to investigate the effect of pre-treatment solutions.

Apple chips were appreciated by sensory analysis. The texture by Brookfield Texture Analyser and colour was determined according to C.I.E.LAB system (L*,a*,b*) using a tristimulus colorimeter.

According to the results, chips from cultivar "Idared" with treatment ascorbic acid was the best one, chips from candidate "MR-10" follow it. Under the sensory value we drawn conclusion that dried apple slices treated by citric acid are better, particularly the colour values. It was found that all of the apple candidates are suitable for dried apple producing.

It can be state without using sulphur in drying technology it can be produce dried apple chips with good quality and convenient colour.

1. INTRODUCTION

Apple is the second widely cultivated fruit in Hungary. Commercially, apples can be stored for some months in controlled-atmosphere chambers and they have good qualitiy under storage also. Fruit industry would like to process better quality fruits and vegetables, costumers would like to consume healthier foodstuffs without any additives.

Nowadays old apple cultivars are often oddly shaped, russeted, and have a variety of textures and colours. They have other problems which make them commercially unviable, such as low yield, liability to disease, or poor tolerance for storage or transport. Because of this and the requires of the food industry and consumers desired qualities in modern commercial apple breeding are a colourful skin, absence of russeting, ease of shipping, lengthy storage ability, high yields, disease resistance. In Europe several country deals with selective breeding against different fruit diseases. An apple breeding program was started in the 1990s at Faculty of Horticultural Science, Corvinus University of Budapest, Hungary in order to widen the selection of Hungarian apple cultivars for table, industrial processing, or dual-purpose (Tóth, 1994).

Apple has widely processing opportunities. It can be processed for pulp, dried slices (chips), juice, and concentrate. Clarified apple juice is one of the most consumed juices in the world. Dried apple slices have increasing tendency, because they are healthier than chips were fried in oil, they do not content any food additives.

Drying as a preservation method for foods has been practised since the earliest times recorded history. Dried fruits show increasing tendency because they are a rich source of other antioxidant compounds which may be cancer-protective. The predominant phenolic phytochemicals in apples are quercetin, epicatechin, and procyanidin B2. The fiber content, while less than in most other fruits, helps regulate bowel movements and may thus reduce the risk of colon cancer. They may also help with heart disease, weight loss, and controlling cholesterol, as they do not have any cholesterol, have fiber, which reduces cholesterol by preventing reabsorption, and are bulky for their caloric content, like most fruits and vegetables.

In our work we focused drying several Hungarian multi-resistant and control cultivars. Two pre-treatment solutions were used to inhibit the enzymatic browning. Sulphur was not used in the experiments. Our purpose was to evaluate the quality of the dried slices, and investigate producing apple chips without Sulphur.

2. MATERIALS AND METHODS

2.1. Materials

Apple varieties and candidates were harvested in 2009 at Experimental Orchard of the Faculty of Horticultural Science, Corvinus University of Budapest, Hungary. All of the samples were in same maturity.

Dried apple slices (chips) were manufactured from four multi-resistant candidates (MR-03, MR-09, MR-10, MR-12) and two conventional, control varieties: Idared and Jonathán. Before the experiments, the apples were stored at 3°C and 90% relative humidity.

2.2. Methods

2.2.1. Composition of raw materials was determined by measuring the water soluble dry matter (Codex Alimentarius 3-1-558/93), total acid expressed in malic acid (H. St. No. 3619:1983), pectin content (Dietz és Rouse, 1953) total polyphenol content by Folin-Ciocalteau method according to Singleton and Rossi (1965).

2.2.2. Pre-treatments

Two types of pre-treatment were applied to the apple slices:

(a) Soaking of the apple slices in ascorbic acid solution of 1%, 1 min. at room temperature

(b) Soaking of the apple slices in citric acid solution of 1%, 1 min. at room temperature (Son et. al, 2001)

2.2.3. Drying method: in every case were 70°C, 6 hs

2.2.4. Examinations of the products

Colour parameters were determined according to C.I.E.LAB system (L*,a*,b*) using a tristimulus colorimeter (Konica Minolta CR 410, Minolta Canada Inc., Mississauga, ON). Texture was investigated by Brookfield, LFRA 4500 Texture Analyser. Sensory evaluation was performed according to H. St. 7304/3-86 and 1801:1989. with special regard to the colour.

3. RESULTS AND DISCUSSION

3.1. Results of raw materials

Refraction and pH values can be seen in Table 1. They showed similar values in range of 12,2-14,6 and 3,4-3,6.

Table 1. Refraction and pH values

	Refraction	pH
MR-03	**12,2**	**3,4**
MR-09	**14,6**	**3,5**
MR-10	**13,4**	**3,58**
MR-12	**12,8**	**3,5**
Idared	**13,9**	**3,57**
Jonathán	**13,9**	**3,6**

Fig. 1 shows the titratable acid content expressed in malic acid. Acidity of apples is an important quality factor because of the convenient sugar-acid ratio, and comfortable flavour.

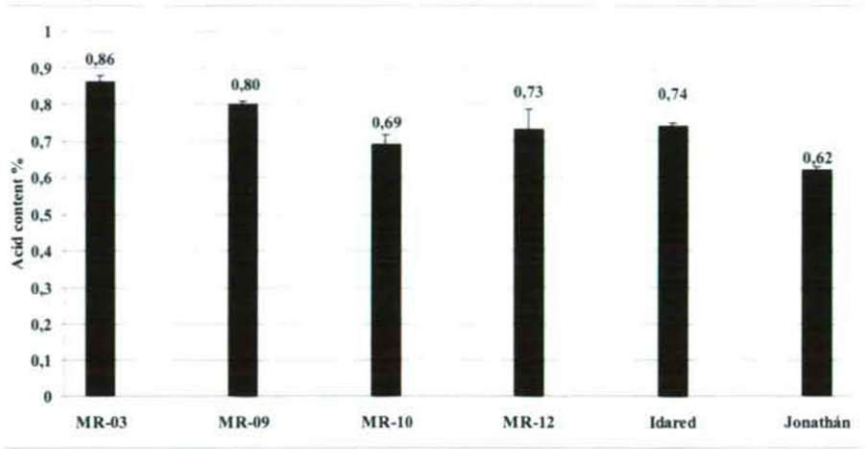

Figure 1. Acid content of the samples

Acid content of apple candidates and varieties was between 0,62 and o,83 %. The highest acid content (0,83 %) was observed in case of candidate MR-03 indicating that it. The variety of Jonathán has the smallest acid content (0,62 %).

Pectin content is shown in **Fig. 2**. It can be seen that candidates MR-03 and MR-10 have the highest pectin content. The control varieties have the smallest pectin content, and they have similar values. Pectin is very important in apples because the have important role in texture.

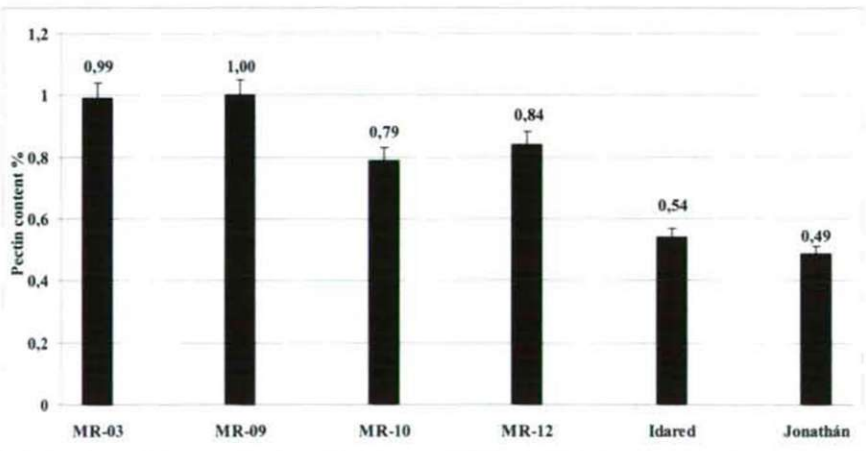

Figure 2. Pectin content of the samples

Polyphenol content was shown in Fig. 3. Candidates have polyphenol content in range 888-1105 mg/l.

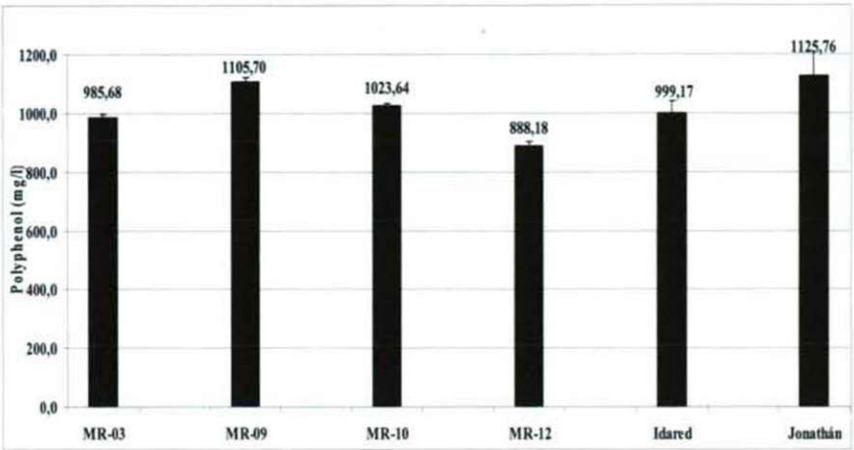

Figure 3. Polyphenol content of the samples

3.2. Evaluation of the products

In Table 2. shows the best points of the samples during sensorial analysis. It can be seen that except the colour, the best points were given to the products pre-treated by ascorbic acid.

Table 2. Sensorial best points of the products

	Best points	Sample
Colour	17.67	Jonathán citric acid
Odour	6.86	MR-10 ascorbic acid
Flavour	35.40	Idared ascorbic acid
Texture	18.40	Idared ascorbic acid
General aspect	8.29	Idared ascorbic acid

In evaluation of the products the main respects were the colour and texture. By the results of colour measurement it can be seen, that dried slices which were pre-treated by citric acid are the lightest samples (Table 3.). Slices pre-treated by ascorbic acid have reddish tint. It was shown by the high a* values (Table 4.).

Table 3. L values of the samples*

L* values	Control	Citric acid	Ascorbic acid
MR-03	83,66	***84,79***	82,12
MR-09	***82,79***	75,76	70,78
MR-10	82,62	***85,05***	70,80
MR-12	77,13	***81,34***	64,10
Idared	78,49	***80,14***	77,33
Jonathán	78,40	80,51	***86,45***

Table 4. a values of the samples*

a* values	Control	Citric acid	Ascorbic acid
MR-03	0,48	-1,34	1,72
MR-09	0,66	4,42	***16,17***
MR-10	0,54	-1,28	***15,19***
MR-12	5,34	0,83	***16,13***
Idared	3,17	3,36	***5,45***
Jonathán	2,70	3,01	-3,18

In case of total colour difference (Fig. 4) it can be seen, that products pre-treated by citric acid have higher ΔE* values. Every case the control sample was the un-treated products.It means, the colour of these products have high colour differences to the un-treated products. They have better and lighter colour. If we evaluate this it can be seen (Table 4.), that the colour differences are visible, except in case MR-03 pre-treated by ascorbic, because this difference is markable.

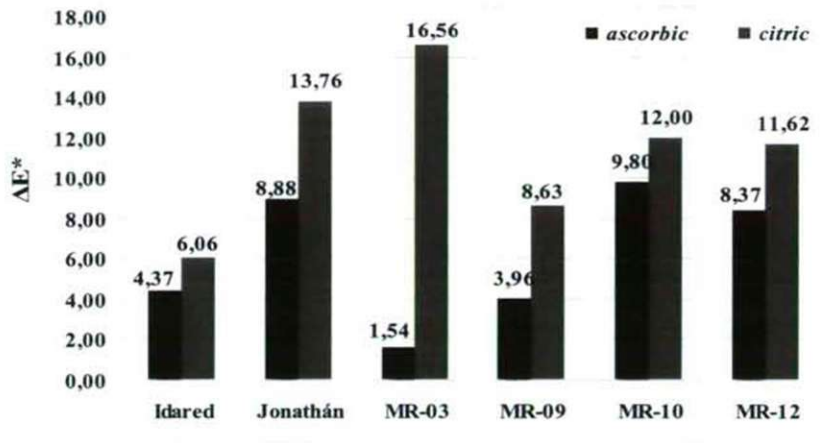

*Figure 4. Values of ΔE **

Table 4.Evaluation of total colour differences

ΔE * values	Percept Difference
0-0.5	Non markable
0.5-1.5	Less markable
1.5-3.0	Markable
3.0-6.0	Visible
6.0-12.0	High

In the course of texture examination, hardness, adhesion, and elasticity were measured, because in the evaluation of the quality of dried apple slices these parameters are important aspects. Fig. 5. shows a texture profile.

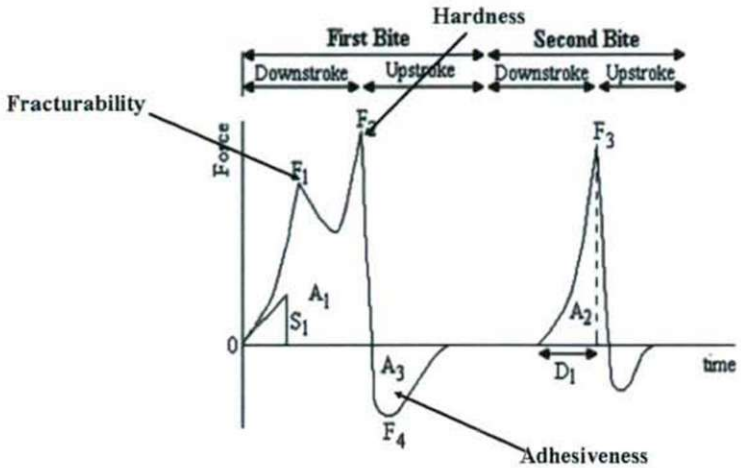

Figure 5. Texture profile

Hardness is the measure of how resistant solid matter is to various kinds of permanent shape change when a force is applied.
Because texture was get the highest points during sensorial analysis in case of samples pre-treated by citric acid, these texture values are shown in Fig. 5. it can be seen, hardness values are between 242-386 g. The hardest sample is purchased one, and the softest one is variety Jonathán.

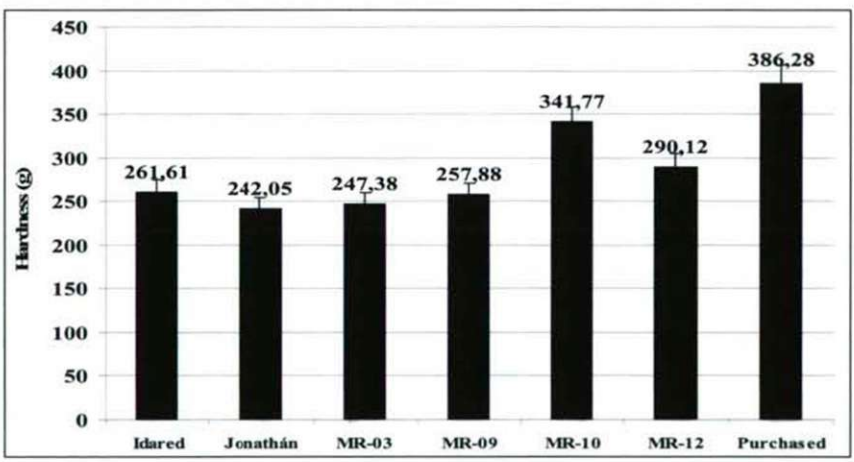

Figure 6. Hardness values of samples pre-treated citric acid

Adhesion is the work necessary to overcome the attractive forces between the surface of the food and the surface of the material with which the food comes into contact (e.g. tongue, teeth, and palate). Work required pulling food away from a surface.
Adhesion values of samples pre-treated by citric acid are shown in Fig.6.

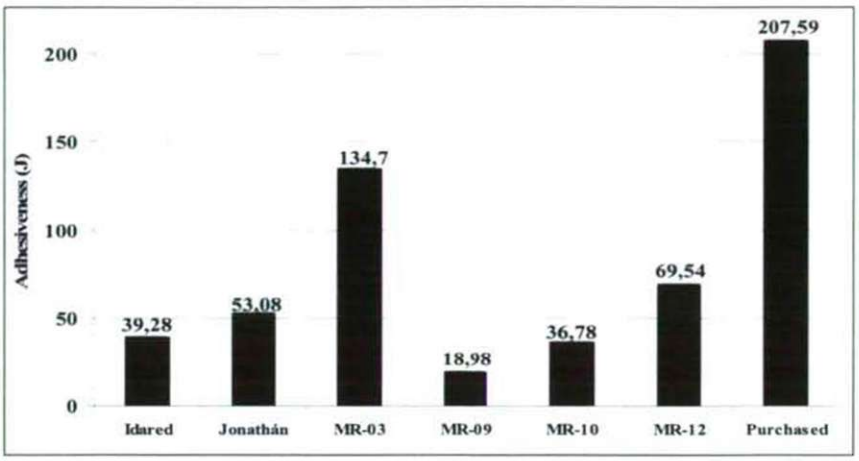

Figure 7. Adhesion values of samples pre-treated by citric acid

4. CONCLUSION

Food industry has continuous development. Costumers like choose healthier foodstuffs, rich in vitamins, antioxidants, fibre, and request without food additives. Very important to breed new apple candidates which are resistant against fruit diseases. They are promising because of the smaller scale use of pesticides (environmental friend technology), and they have similar fruit quality to the commonly grown susceptible cultivars. The new candidates are characterized by good quality and excellent productivity.

Among the apple products dried apple slices have importance, because of the healthier, natural aspect.

In our work apple were dried without using Sulphur, ascorbic and citric acid were used to inhibit enzymatic browning. Dried slices were evaluated by colour and texture values, and sensory analysis. Consider of the sensorial results, the best one was variety Idared pre-treated ascorbic acid; second one was candidate MR-10 citric acid.

At the end of our work It can be state without using sulphur in drying technology it can be produce dried apple chips with good quality and convenient colour from new multiresistant apple candidates and commercially varieties also.

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